ABSTRACT

Purpose. To evaluate the treatment outcome of Philos plate fixation for displaced proximal humeral fractures in 27 consecutive patients.

Methods. 6 men and 21 women aged 22 to 85 (mean, 56) years underwent Philos plate fixation for displaced proximal humeral fractures. 11 patients were aged ≤60 years and 16 >60 years. All fractures were closed with no associated injuries and classified as 2-part (n=13), 3-part (n=12), and 4-part (n=2), according to the Neer classification. Patients were assessed radiologically and functionally using the Constant shoulder score.

Results. Patients were followed up for 6 to 24 (mean, 13) months. All the fractures united except in a 76-year-old woman with a 3-part fracture in whom there was fracture collapse and screw penetration of the humeral head at 6 weeks. She subsequently developed non-union and avascular necrosis. The mean Constant shoulder score was 70 (range, 28–88). 11 patients had a score exceeding 75, 13 were scored between 50 and 75, and 3 were below 50.

Conclusion. Philos plate fixation provided stable fixation, minimal metal work problems and enabled early range-of-motion exercises to achieve acceptable functional results.

Key words: bone plates; humeral fractures

INTRODUCTION

Proximal humeral fractures account for 4 to 5% of all fractures. Most are stable and minimally displaced and can be treated non-operatively with good results. Displaced and unstable fractures are difficult to manage and have a high morbidity. The treatment goal is to achieve a painless shoulder with full function. Various methods have been used, including Kirschner wire fixation, suture fixation, external fixation, tension band fixation, Rush pin fixation, intramedullary nailing, and prosthetic replacement with plating.

Locking plate fixation provides angular and axial...
stability and minimises the risks of screw toggle and pull out as well as reduction loss. Divergent or convergent locked screws improve the pull out resistance of the whole construct.\textsuperscript{11} Locking plates fail at a greater load than non-locking plates.\textsuperscript{12} Philos plates are pre-shaped and pre-contoured locking compression plates, with an aiming device for insertion of the locking screws and positioning of the plate to prevent impingement. We evaluated treatment outcome of Philos plate fixation for displaced proximal humeral fractures in 27 consecutive patients.

**MATERIALS AND METHODS**

Between June 2003 and June 2006, 6 men and 21 women aged 22 to 85 (mean, 56) years underwent Philos plate fixation for displaced proximal humeral fractures. 11 patients were aged ≤60 years and 16 >60 years. The causes of injury were falls (n=21) and road traffic accidents (n=6). All the fractures were closed with no associated injuries and classified as 2-part (n=13), 3-part (n=12), and 4-part (n=2), according to the Neer classification.\textsuperscript{13} Patients were placed in a beach-chair position under general anaesthesia. A delto-pectoral incision was made. The fractures were reduced and temporarily held with Kirschner wires and sutures. Reduction was confirmed using an image intensifier. A philos plate was applied with at least 4 locking proximal screws and 4 non-locking distal screws. Postoperatively the arm was placed in a sling. Passive-assisted movements were started on day 1, followed by active-assisted exercises after 3 weeks. Patients were assessed radiologically and functionally using the Constant shoulder score.\textsuperscript{14}

**RESULTS**

Patients were followed up for 6 to 24 (mean, 13) months. All the fractures united except in a 76-year-old woman with a 3-part fracture in whom there was fracture collapse and screw penetration of the humeral head at 6 weeks (Fig.). She subsequently developed non-union and avascular necrosis. The screws were removed but she refused further surgery and had a poor Constant score. There were no wound infections. The mean Constant shoulder score was 70 (range, 48–88). 11 patients had a score exceeding 75, 13 were scored between 50 and 75, and 3 were below 50. Constant scores in 2-, 3-, and 4-part fractures were compared (Table).

**DISCUSSION**

Non-operative treatment for displaced proximal humeral fractures is still advocated; patient satisfaction is high, especially in those with 2-part fractures\textsuperscript{15} or the elderly with low functional demand despite poor

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**Table**  
**Comparison of Constant scores**

<table>
<thead>
<tr>
<th>Constant score</th>
<th>2-part fracture (n=13)</th>
<th>3-part fracture (n=12)</th>
<th>4-part fracture (n=2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (range)</td>
<td>79 (48–88)</td>
<td>73 (26–88)</td>
<td>58 (48–68)</td>
</tr>
<tr>
<td>&gt;75</td>
<td>8 (62)</td>
<td>3 (25)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>50–75</td>
<td>4 (30)</td>
<td>8 (67)</td>
<td>1 (50)</td>
</tr>
<tr>
<td>&lt;50</td>
<td>1 (8)</td>
<td>1 (8)</td>
<td>1 (50)</td>
</tr>
</tbody>
</table>

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**Figure**  
Radiographs showing (a) a displaced 3-part proximal humeral fracture, (b) a healed fracture, and (c) screws penetrating the humeral head.
reduction on radiographs and low Constant scores.\textsuperscript{16} Surgical treatment with minimal soft tissue stripping enables satisfactory reduction, stable fixation, and early mobilisation, but the technical difficulties include poor bone stock, minimum subchondral bone in the humeral head, and excessive soft tissue damage. The most common risks include screws cut out and backed out, penetration of the humeral head, loss of reduction, avascular necrosis, and subacromial impingement.

PlantTan plate fixation with 2 cancellous screws resulted in a 100% failure rate in elderly patients with osteoporotic bone.\textsuperscript{8} Fixation using 2 one-third tubular plates resulted in a complication rate of 12%, including implant loosening, avascular necrosis, subacromial impingment, frozen shoulder, and fracture redisplacement.\textsuperscript{10} Tension band wiring and non-operative treatment had similar functional outcomes.\textsuperscript{17,18} The former was superior in 4-part fractures and the latter in 3-part fractures.\textsuperscript{17} AO T-plate fixation also had an high complication rate, including deep infection (4/32), impingement needing plate removal (5/32), and avascular necrosis (4/32).\textsuperscript{3} Cloverleaf plate fixation achieved good results, but a hemiarthroplasty was recommended in elderly patients with poor bone stock.\textsuperscript{19} Although hemiarthroplasty achieved good pain relief, its functional results were unpredictable and its strength poor.\textsuperscript{20,21} Reverse shoulder prosthesis fixation achieved better functional outcomes.\textsuperscript{22} Polarus nail fixation yielded good results\textsuperscript{6} and was useful in combined neck and shaft fractures,\textsuperscript{23} but the complication rate was high (proximal screw loosening [3/20], revision surgery [2/20], and lateral metaphyseal comminution predisposing to implant failure).\textsuperscript{24} Revision surgery was required in 17% of patients due to non-union, avascular necrosis, screw migration, or inadequate position of the implant.\textsuperscript{25} Locking proximal humeral plate fixation achieved acceptable functional results even in osteoporotic bones, but non-union, implant failure, avascular necrosis of the humeral head, and revision surgery have also been reported.\textsuperscript{26,30} Angle stabilising plates were not necessarily associated with good functional outcomes.\textsuperscript{29} Caution is needed in cases of medial comminution during locking plate fixation.\textsuperscript{31}

In our study, Philos plate fixation provided stable fixation with minimal metal work problems and enabled early range-of-motion exercises to achieve acceptable functional results. Nonetheless, the choice of treatment should be based on patient age, functional requirements, bone quality, fracture pattern, and the surgeon’s preference. Prospective randomised trials are needed to compare different methods of fixation.

REFERENCES